

Evaluation of MerCAP™ for Power Plant Mercury Control

Quarterly Technical Progress Report

April 1, 2005 – June 30, 2005

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ABSTRACT

This document summarizes progress on Cooperative Agreement DE-FC26-03NT41993, “Evaluation of MerCAP™ for Power Plant Mercury Control,” during the time-period April 1, 2005 through June 30, 2005. The objective of this project is to demonstrate the performance of MerCAP™, a technology that uses a fixed sorbent downstream of wet and dry scrubbers for removing mercury from coal-combustion flue gas. The project is being funded by the U.S. DOE National Energy Technology Laboratory under this Cooperative Agreement. EPRI, Great River Energy, and Southern Company are project co-funders. URS Group is the prime contractor.

The general concept for MerCAP™ is to place fixed structure sorbents into a flue gas stream to adsorb mercury and then, as the sorbent surfaces become saturated, thermally or chemically regenerate the sorbent and recover the mercury. One example includes parallel gold-coated plates. Mercury forms an amalgam with the gold and is removed from the flue gas flowing past the plates. The captured mercury can be subsequently sequestered using a carbon canister or cryogenic trap during regeneration.

In this project, URS Group and its team are conducting tests at two host power plants to evaluate gold MerCAP™ performance downstream of a spray dryer-baghouse and wet scrubber over an extended period of flue-gas exposure. The spray dryer site, Site 1, is Great River Energy’s Stanton Station, which burns a ND lignite coal and a Powder River Basin (PRB) sub-bituminous coal. At this site, an array of gold-coated MerCAP™ plates are incorporated into the outlet plenum of one compartment (6 Megawatt Equivalent (MWe)) of the Unit 10 baghouse. Site 2, the wet scrubber site, is Southern Company Services’ Plant Yates Unit 1, which burns an Eastern bituminous coal. An array of gold-coated structures will be configured in a 2800 actual cubic foot per minute (acfm) slipstream (1 MWe) receiving flue gas immediately downstream of a full-scale FGD absorber. MerCAP™ will be evaluated for mercury removal during normal boiler operation for periods of six months at both sites.

MerCAP™ technology has been successfully tested in small-scale units installed at the proposed test sites. Results of this study will verify this performance at a larger scale and over a longer period of gas exposure and will provide data required for assessing the feasibility and costs of a full-scale MerCAP™ application.

During this reporting period, no field work was performed on the site 1 installation, however the economic analysis for site 1 was initiated. Further preparations were made for the site 2 installation at Plant Yates. The installation of this MerCAP™ unit has been delayed until the next quarter due to issues with the host site pilot scrubber and interference with other DOE programs scheduled to take place at Plant Yates Unit 1.

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INTRODUCTION

This document is the seventh quarterly Technical Progress Report for the project “Evaluation of MerCAP™ for Power Plant Mercury Control,” (DE-FC26-03NT41993) for the time-period April 1, 2005 through June 30, 2005. The objective of this project is to demonstrate the performance of MerCAP™, a technology that uses a fixed sorbent downstream of wet and dry scrubbers for removing mercury from coal-combustion flue gas. The project is being funded by the U.S. DOE National Energy Technology Laboratory under this Cooperative Agreement. EPRI, Great River Energy, and Southern Company are project co-funders. URS Group is the prime contractor.

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Great River Energy is providing co-funding and technical support to this project and is providing Stanton Station Unit 10 as a host site. Unit 10 fires North Dakota Lignite and Powder River Basin (PRB) subbituminous fuels and is configured with a spray dryer as a dry FGD system, with a downstream baghouse for particulate control. At this site, an array of gold-coated MerCAP™ plates is incorporated into the outlet plenum of one compartment (6 MWe) of the Unit 10 baghouse.

Southern Company is providing co-funding and technical input to this project and its subsidiary, Georgia Power, is providing its Plant Yates as a host site for testing. Plant Yates Unit 1 fires a low-sulfur bituminous coal and is configured with a small-sized ESP for particulate control, and a downstream CT-121 Jet Bubbler Reactor (JBR) wet FGD system. Gold-coated structures will be configured in a 2800 acfm slipstream downstream of the full-scale FGD absorber.

The ability to repeatedly thermally or chemically regenerate exposed MerCAP™ plates is a critical component to the overall economics of the technology. Therefore, during the longer-term tests, small-scale tests are being conducted to evaluate the mercury removal effectiveness at both sites following repeated regeneration cycles. Tests are being conducted using a 40-acfm slipstream probe device (“Mini-MerCAP™ probe”). Gold-coated substrates from the same production batch used for the MerCAP™ arrays in the larger longer-term tests are used in the Mini-MerCAP™ probe.

MerCAP™ technology has been successfully tested in small-scale units installed at the host sites. Results of this study will verify this performance at a larger scale and over a longer period of gas exposure and will provide data required for assessing the feasibility and costs of a full-scale MerCAP™ application.

This report describes the activities carried out for this program during the project-reporting period of April 1, 2005 through June 30, 2005. The remainder of this report is divided into four sections: an Executive Summary followed by sections that describe Experimental Procedures, Results and Discussion, and Conclusions.

EXECUTIVE SUMMARY

Summary of Progress

The current reporting period, April 1, 2005 through June 30, 2005, is the seventh full technical progress reporting period for the project. Efforts during the current period focused on tasks associated with preparation for the site 2 MerCAP™ installation.

Site 1 Activities

Field-testing of the MerCAP™ installation at site 1 was completed in March 2005. There has been no further field-testing at site 1. The economic analysis of the site 1 results was initiated during this reporting period. These results will be reported in subsequent reporting periods.

Table 1 lists the planned and completed milestones for this project.

Table 1. Schedule for Year 1 Milestones for this Test Program.

Milestone	Description	Planned Completion	Actual Start/ Completion
1	Submit Hazardous Substance Plan	Q1	Q1/Q1
2	Submit Test Plan	Q1	Q1/Q1
3	Frame Installation/Baseline Monitoring Site 1	Q1	Q1/Q2
4	Site 1 Gold Installation, Intensive Testing	Q1	Q1/Q3
5	Start of Long Term Testing, Site 1	Q3	Q3
6	End of Long Term Site 1, Gas Char Tests	Q3	Q3/Q2(2005)
7	Site 1 Review/ Site 2 Planning Meeting	Q3	Q4
8	Frame Installation/Baseline Monitoring Site 2	Q4	Q4(2005)

Site 2 Activities

Tests at Site 2 will evaluate gold MerCAP™ performance downstream of a wet FGD absorber in flue gas derived from Eastern bituminous coal. The fixed sorbent structure will be configured in a flue gas slipstream (approximately 2800 acfm) located downstream of the Plant Yates Unit 1 JBR reactor. The slipstream is part of an existing pilot scrubber setup installed previously by Southern Company. Work during this reporting period included that associated with further preparation for the final installation.

Figure 1 is a photograph of the constructed housing that will contain the gold substrates for the MerCAP™ installation at Site 2. Figure 2 is a photograph of one of the three MerCAP™ gold substrate modules that will be installed in the pilot housing.

The unit was completed in February and shipped to the plant where it is currently awaiting installation. The MerCAP™ test unit was not immediately installed at Site 2 due to scheduling conflicts with other DOE test programs on Yates Unit 1 and a planned outage. During this reporting period, the schedule of the MerCAP™ installation was impacted by preparations for DOE scrubber additive tests (DE-FC26-04NT42309) at Plant Yates that will utilize Southern Company's pilot scrubber. Southern Company experienced long delays in preparing the pilot scrubber for operation and has reconfigured the unit to accommodate the scrubber additive tests. Installation of the MerCAP™ unit for this site is now scheduled for August 2005. The unit will be operated briefly before a scheduled outage lasting from October 1 to November 20. During this time the MerCAP™ will be isolated and testing will resume when the unit comes back on line in November. After the outage the MerCAP™ will be operated continuously for at least 6 months.

The test unit will be installed in a long horizontal run of pipe to the inlet of Southern Company's pilot scrubber that was previously identified as the best location for the installation. This location was selected because the MerCAP™ unit could be easily retrofitted into the existing system at this point, and because the run of pipe is relatively close to the ground that will aid in the future sampling activities as well as configuration and installation of the gold plates. The MerCAP™ reactor will be located just upstream of the pilot scrubber (which will not be operated during the MerCAP™ tests). A fan, configured on the pilot unit, will provide the motive force for the flue gas across the MerCAP™ unit. Flue gas exiting the reactor will be flowed back to the Unit 1 duct.



Figure 1. Wet MerCAP™ Housing for Installation at Site 2

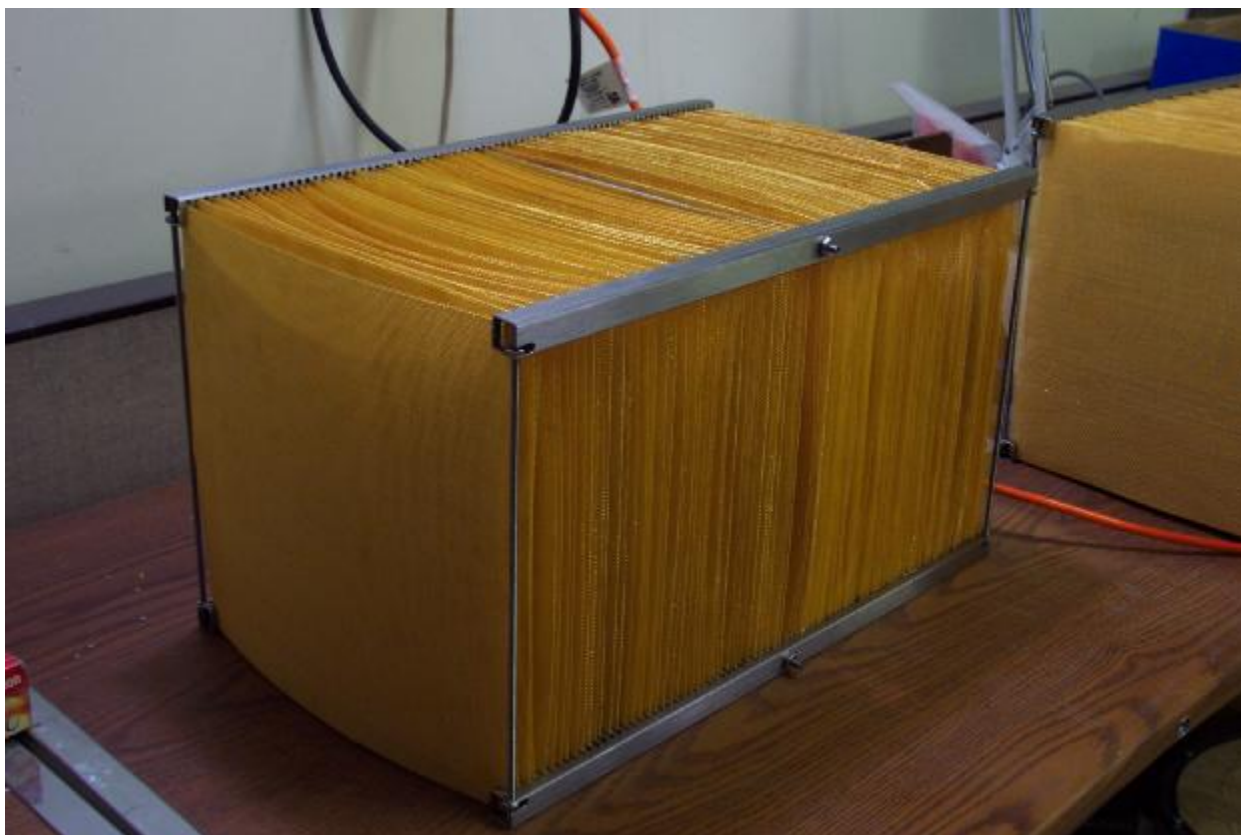


Figure 2. Gold Substrate Module for the Wet MerCAP™ System

The MerCAP™ reactor will be constantly monitored for inlet and outlet temperature, static pressure, pressure drop, and flow. A data logger located on site will continuously collect this data. Ports fitted upstream and downstream of the gold plates will allow access points for mercury measurements, and a wash water system will also be fitted to the system to allow for periodic cleaning of the gold screens.

Sub-Contracts

No subcontracts were awarded during this reporting period.

Task Activity Summary

Table 2 lists the current activity status of the primary tasks for this program. MerCAP™ installation and testing had been delayed at Plant Yates Unit 1 due to a conflicting DOE carbon injection program at this host site; the latter was delayed due to schedule constraints associated with performance of a long-term demonstration test. The carbon injection program ended in December 2004, however a scheduled outage at Plant Yates Unit 1 in April and DOE scrubber additive tests (DE-FC26-04NT42309) further delayed the MerCAP™ installation until the second quarter of 2005. Further delays in getting the Southern Company pilot scrubber to an operational state has delayed the MerCAP™ installation until the 4th quarter of 2005. The 6-month operation and testing period for Stanton has been reached and exceeded (7.3 months).

Remaining test resources will focus on a better understanding of the plant operating parameters on MerCAP™ performance.

Table 2. Project Activity Status.

Task Number	Description	Planned % Completion	Actual % Completion
1	Project Planning	90%	90%
2	Stanton MerCAP™ Testing	100%	100%
3	Yates MerCAP™ Testing	10%	10%
4	Economic Analysis	10%	10%
5	Project Management & Reporting	50%	50%

Problems Encountered

The installation of the MerCAP™ test unit at Site 2 was delayed at the request of the host site due to delays in getting the pilot scrubber to an operational state, and conflicts with other mercury related DOE projects scheduled to occur simultaneously with the MerCAP™ at Plant Yates Unit 1. During this reporting period, the start-up schedule was impacted by DOE scrubber additive tests that have potential to reduce the flue gas mercury concentration entering the MerCAP™ test unit. These scrubber additive tests were also delayed by the refurbishment of the Southern Company pilot scrubber that has become operational at the end of July. The scrubber additive tests are currently scheduled for mid August with the MerCAP™ installation to take place immediately after.

Plans for Next Reporting Period

The next reporting period covers the time-period July 1 through September 30, 2005. During this quarter, the MerCAP™ reactor for Site 2 will be installed. The system will be put into service without gold plates and baseline mercury measurements will be made. The gold plates will then be installed after the baseline period and initial mercury measurements will be collected across the unit.

Prospects for Future Progress

The planned demonstration under the DOE-funded effort at Site 1 is coming to completion. The possibility of continued operation and sources of funding for the MerCAP™ testing at the host site is being investigated. At 5300 hours of operation, 7.3 months of service, the mercury removal performance has been averaging 30% on the original module of gold substrates. The primary detrimental impacts on the technology appear to be spray dryer operating conditions and duct temperature excursions, both of which appear to only have a temporary impact. Additional

parametric tests at Site 1 and pending results from Site 2 should help with understanding the mercury gold amalgamation process in the presence of flue gas.

RESULTS AND DISCUSSION

No results were collected during this reporting period.

CONCLUSIONS

No conclusions were made during this reporting period.

REFERENCES

No References.